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RESOLUTION A.818(19)
adopted on 23 November 1995

PERFORMANCE STANDARDS FOR SHIPBORNE LORAN-C AND CHAYKA RECEIVERS

THE ASSEMBLY,

RECALLING Article 15(j) of the Convention on the International Maritime Organization concerning the functions of the Assembly in relation to regulations and guidelines concerning maritime safety,

HAVING ADOPTED by resolution A.815(19) the IMO policy for the recognition and acceptance of suitable radionavigation systems intended for international use to provide ships with navigational position-fixing throughout their voyages,

RECOGNIZING that the Maritime Safety Committee has identified that the Loran-C and Chayka systems may be regional components of the world-wide radionavigation system,

NOTING that shipborne receiving equipment for the world-wide radionavigation system should be designed to satisfy the detailed requirements of the particular system concerned,

HAVING CONSIDERED the recommendation made by the Maritime Safety Committee at its sixty-fourth session,

1. ADOPTS the Recommendation on Performance Standards for Shipborne Loran-C and Chayka Receivers set out in the Annex to the present resolution;

2. INVITES Governments to ensure that Loran-C or Chayka receivers carried on ships of their flag conform to the performance standards set out in the Annex to the present resolution;

3. REQUESTS the Maritime Safety Committee to keep these Performance Standards under review and to adopt amendments thereto, as necessary.

ANNEX

RECOMMENDATION ON PERFORMANCE STANDARDS FOR SHIPBORNE LORAN-C AND CHAYKA RECEIVERS

1 INTRODUCTION

1.1 The Loran-C and Chayka systems are long-range radionavigation systems, operating at an assigned frequency of 100 kHz, utilizing pulses with known Group Repetition intervals from spaced transmitting stations. Lines of position are determined by the measurement of the differences in the time of arrival of these pulses.

1.2 Receivers for the Loran-C or Chayka system, or both, intended for navigational purposes on ships with maximum speeds not exceeding 35 knots should, in addition to the general requirements contained in resolution A.694(17), comply with the following minimum performance requirements.

1.3 The equipment should comply with these standards within 7.5 min of being switched on.

1.4 Definitions of terms used in these performance standards are given in section 8.

2 PERFORMANCE STANDARDS FOR THE RECEPTION OF LORAN-C AND CHAYKA SIGNALS

2.1 The receiver should be capable of taking measurements of time differences, and of calculating and displaying the current position estimate. The processing should be such that the combined timing accuracy of each time difference used in the navigation solution is better than 0.3 µs.

2.2 The receiver, together with its antenna, should have the capability of fully automatic acquisition of the signals, cycle selection and tracking. The receiver should allow, but not require, operator assistance to acquire the secondaries.

2.3 The receiver, together with its antenna, should be capable of providing the combined timing accuracy specified in 2.1 under the following conditions:

.1 in signals of field strength between 17.8 µV/m and 316 mV/m (25 dB/µV/m to 110 dB/µV/m);

.2 with a range of 0 dB to 60 dB between the signal levels of the stations being used for the navigation solution;

.3 with an envelope to cycle difference (ECD) within the range of +2.4 µs to -2.4 µs; and

.4 with a minimum signal to noise ratio of -10 dB for acquisition in a noise level range of 4 µV/m to 5.6 mV/m (12 dB/µV/m to 75 dB/µV/m).

3 INTERFERENCE PROTECTION

3.1 The receiver should meet the requirements of these standards:

.1 when two near synchronous near band sources of interference of 0 dB signal to

interference ratio (SIR) are present; and

.2 in the presence of an interference source of -60 dB SIR relative to the weakest Loran-C or Chayka signal specified in 2.3.1. The interfering signal should be amplitude modulated at 30% at 1,000 Hz, and its frequency should lie outside the band 50 kHz to 200 kHz.

3.2 The receiver should meet the timing accuracy and lock-on requirements of these standards in the presence of cross-rate interference at a level as high as the strongest Loran-C or Chayka signal being used.

3.3 The receiver should distinguish between signals received by ground or sky waves in the service area and should lock on in the presence of skywave interference having delays from 37.5 µs to 60 µs, with strengths of 12 dB to 26 dB respectively, both delays and strengths being measured relative to the groundwave signal.

4 PROCESSING

4.1 The operator should be able to override any automatic selection of chains or stations.

4.2 Maximum time to lock-on should not exceed 7.5 min under any of the conditions specified in sections 2 and 3. It should be possible to select those secondaries which are to be locked and tracked.

4.3 The receiver, together with its antenna, should conform to these standards when subject to ship motion of roll, pitch and yaw under the following conditions:

.1 at speeds up to 16 knots (3.3 µs/min time difference rate of change on the baseline) in any horizontal direction and at accelerations up to 3 knots/min (0.6 µs/min/min time difference acceleration); and

.2 at speeds between 16 and 20 knots (4 µs/min time difference rate of change) the receiver should provide a combined accuracy of 0.45 µs or better.

5 DISPLAY OF POSITIONAL INFORMATION

5.1 The receiver should be capable of displaying time difference measurements and may allow the display of geographical positions calculated from time difference measurements.

5.2 A receiver should be capable of displaying at least two time differences selected by an operator, either sequentially or simultaneously, with the following facilities:

.1 a display of at least six digits providing a read-out to 0.1 µs for each preselected pair of stations;

.2 identification of the pairs of stations between which the time differences have been measured;

.3 when time difference information is displayed sequentially, provision should be made for holding it on the display for as long as it is required, without interrupting the continuous updating of time differences by the receiver;

.4 where provision is made for manually entering corrections in order to display corrected positions, a clear warning indication that the position has been corrected should be

provided. It should be possible to display the applied correction with a polarity sign;

.5 where provision is made for entering precomputed (Additional Secondary Factor) corrections for a given area, in order to display co-ordinates automatically corrected, a clear indication should be provided that the co-ordinates are corrected. Details should be given in the equipment handbook of the propagation model on which these corrections are based;

.6 where geographical co-ordinates are displayed, any additional error due to the co-ordination calculation should not be greater than the equivalent of 0.1 µs. The receiver should be capable of presenting co-ordinates in the form of degrees, minutes and hundredths of minutes. The display should indicate whether latitudes are North or South and longitudes are East or West. Latitude degrees should be displayed by two digits and longitude degrees by three digits; and

.7 means may be provided to transform the computed position based upon (World Geodetic System) WGS 84 into data compatible with the datum of the navigational chart in use. Where this facility exists, the receiver should indicate that co-ordinate conversion is being performed and should identify the co-ordinate system in which the position is expressed.

6 WARNING DEVICES

Warnings should be provided to indicate that:

.1 any station being used is blinking;

.2 the signal has been lost; and

.3 a cycle identification error has been detected.

7 ANCILLARY EQUIPMENT

Loran-C and Chayka receivers may be fitted with outputs to allow the connection of peripheral equipment. Data from these outputs should be in digital form and should comply with Publication IEC 1162.

8 DEFINITIONS

8.1 Group repetition interval (GRI)

The GRI designates the particular chain to which the receiver is adjusted. The four digit numerical designation from 4,000 to 9,999 is the time in tens of microseconds between successive Master group transmissions; e.g., Loran-C chain 9,930 repeats its transmissions at intervals of 99,300 µs.

8.2 Time difference (TD)

Time difference is the difference between the arrival times of the signal from two specified stations.

8.3 Envelope-to-cycle difference (ECD)

Envelope-to-cycle difference is the time relationship between the phase of a Loran-C or Chayka carrier and the time origin of the envelope waveform. Zero envelope to cycle difference is defined as the signal condition occurring when the 30 µs point of the Loran-C or Chayka pulse envelope is in time coincidence with the third positive zero crossing of the 100 kHz carrier.

8.4 Loran-C or Chayka signal level

For the purpose of this standard, the level of a Loran-C or Chayka signal is the root-mean-square (RMS) level of a carrier wave (CW) signal having the same peak-to-peak amplitude as the Loran-C or Chayka pulse envelope 25 µs after the beginning of the pulse. The 25 µs point is referred to as the standard sampling point (SSP).

8.5 Lock-on

A receiver has completed lock-on when it has acquired, and is tracking, the signals of the selected stations. Lock-on time is the interval between the time that the receivers are switched on, or the selected chain or stations are changed, and the time that lock-on is achieved. The lock-on time does not include any time required to tune notch filters.

8.6 Combined timing accuracy

Root sum of squares of mean and standard deviation of the time difference error.

8.7 Noise level

For the purpose of performance specification and testing, the noise is considered to have a uniform spectral density prior to filtering. It should be filtered by a single resonator LC filter having a centre frequency of 100 kHz and a 3 dB bandwith of 30 kHz feeding a load of 50 ohms. The defined noise level is the true RMS level measured at the filter output.

8.8 Near synchronous interference

Interference by a carrier with a frequency difference from the nearest spectral line within the bandwidth of any post-sampling averaging or filtering process.

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